CLINICAL EFFICACY OF SPINAL INSTRUMENTATION IN LUMBAR DEGENERATIVE DISC DISEASE

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ABSTRACT

CLINICAL EFFICACY OF SPINAL INSTRUMENTATION IN LUMBAR DEGENERATIVE DISC DISEASE

In review of 871 lumbar fusion procedures performed over the last eight years, the theoretical advantages of lumbar spinal instrumentation are not borne out in simple discogenic disease. Four groups of thirty to thirty-five patients without previous surgery who underwent fusion by different techniques were matched for age, sex, length of follow up, surgeons, number of levels fused, duration of preoperative symptoms, diagnosis and type of third party payer. At least for the diagnosis of herniated disc with segmental instability and the instrumentation systems used in this study, results were superior with no internal fixation. This is in keeping with the higher complication rates and frequent need for implant removal reported by many authors.

Key words: spinal instrumentation
discogenic disease
fusion

INTRODUCTION

There are many factors that contribute to the success or failure of a spinal fusion procedure. Technical factors are of foremost importance. Despite the commonness of spinal fusion operations, there is very little controlled research available comparing clinical results of various lumbar fusion techniques. A great deal of effort has gone into development of sophisticated lumbar instrumentation though its clinical role as an adjunct to spinal fusion is not well defined. Lee has compared posterior lateral fusions with and without Luque rods and Knodt rods and found better results with Luque rods.[12] There is a myriad of papers showing satisfactory and unsatisfactory results using particular fusion techniques.[2,3,4,5,6,8,11,13,14,15,16,17,18,19,20,21,22] Because of the difficulties in running control groups in this setting, one cannot objectively decide which techniques are most effective in a given clinical situation. The theoretical advantages of lumbar spinal instrumentation and the enthusiasm for its use are formidable but the specific situations where one can expect a more favorable result are not clear based on objective data presently available.

MATERIALS

We reviewed 871 lumbar spine fusion procedures per-

formed between 1978 and 1986 in an attempt to assess general clinical efficacy of four different lumbar fusion techniques. We attempted to control the principle variables by selecting matched groups of approximately 30 patients in each. Sufficient numbers of matchable cases were only available for patients with the diagnosis of herniated disc with segmental instability. There were 30 to 36 cases in each of four groups. All cases in the study met the following criteria:

1) No previous spinal surgery;
2) No litigation or workers' compensation involvement;
3) All fusion procedures were performed by a combination of two of the authors who used essentially identical posterior lateral and instrumentation technique;
4) All patients had L3 or L4 to S1 posterior lateral fusions utilizing autologous iliac crest bone graft with at least two level discectomies;
5) No history of psychiatric abnormal illness or diagnosis;
6) All patients had herniated discs with symptoms of central back pain greater than leg pain, increasing symptom intensity with increasing activity and maintenance of status positions such as sitting, with or without abnormal motion noted on bending films.

METHODS

Patients were categorized into four groups (Table I-IV): Group 1 - posterior lateral fusions and discectomies without internal fixation (NIF), group II - posterior lateral fusion, discectomies with Knodt rods (KR), group III - posterior lateral fusion, discectomies with Harrington rods (HR), Group IV - posterior lateral fusion, discectomies, and variable spine plating (VSP).

TABLE I

	(NIF)	(KR)	(HR)	(VSP)
Group	I	II	III	IV
Number Patients	30	36	30	30
Average Age	40	45	47	45
Age Range	22-59	19-76	28-74	24-76
Levels				
L4-S1	28	27	27	26
L3-S1	2	2	3	4
Preop symptoms				
Duration	1.9 yrs	2.8	2.4	2.1
Range	9mo-10 yr	8mo-14yr	1-15yr	1-14yr
F/U Period	3.1yrs	2.8yrs	1.0yrs	2.7yrs
F/U Range	2-4yrs	2-4.5yrs	1.0-4.5	2-4yrs

A non-orthopaedist independent MD research fellow reviewed clinical charts and contacted by phone all patients or their families in the event of patient unavailability. Radiographs

were reviewed for evidence of fusion solidity and hardware failure. Patients were categorized in the following clinical categories:

Excellent - no pain, no functional limitations.

Good - occasional mild pain, minimal functional limitations, rare analgesic intake, symptoms allow return to former occupation.

Fair - improved from preoperative state, occasional analgesic intake, significant functional limitations.

Poor - same or worse from preoperative state, frequent analgesic intake, moderate to severe frequent pain, significant functional limitations.

The decision as to which of the four types of fusion to be performed was a result of the time period that the patients presented for their surgery. That is, the technique of two and three level fusion varied from 1978 to 1986 according to specific time period when a specific technique was considered most efficacious; so that from 1978 to 1981 most group I (NIF) were performed while Group II (KR), Group III (HR), and Group IV (VSP) followed chronologically during different periods, respectively.

Each patient had AP and flexion-extension lateral radio-

graphs for follow up of fusion solidity until fusions were felt to be solid.

RESULTS

Overall clinical results at the time of follow up considering patients who required re-operation as poor results are shown in Table II. Results at the time of follow up regardless of whether a re-operation was performed are shown in Table III.

TABLE II

OVERALL CLINICAL RESULTS

	Excellent	Good	Fair	Poor
NIF n=30	50%(15)	30%(9)	16%(5)	3%(1)
KR 36	53%(19)	14%(5)	22%(8)	11%(4)
HR 30	40%(12)	7%(2)	3%(1)	50%(15)
VSP 30	47%(14)	23%(7)	10%(3)	20%(6)

TABLE III

Clinical Results at time of follow up regardless of whether second operation was performed were:

	Excellent	Good	Fair	Poor
NIF n=30	50%(15)	30%(9)	16%(5)	3%(1)
KR 36	53%(19)	22%(8)	22%(8)	3%(1)
HR 30	53%(16)	13%(4)	7%(2)	27%(8)
VSP 30	47%(14)	27%(8)	20%(6)	7%(2)

Postoperative complications are lifted in Table IV.

TABLE IV

COMPLICATIONS

Group	I **NIF**	II **KR**	III **HR**	IV **VSP**
Early Complications				
Wound Infection	0	0	1(3%)	1(3%)
Ileus	2(6%)	0	1(3%)	2(6%)
Cardiac	1(3%)	1(3%)	0	1(3%)
Pseudomeningocele	0	0	1(3%)	0
Hematoma	0	1(3%)	0	0
UTI	0	0	1(3%)	1(3%)
Pulmonary Emboli	0	0	0	1(3%)
Late Complications				
Juxta-Fusion Symptoms	0	2(6%)	4(13%)	1(3%)
Pseudarthrosis	5(17%)	4(11%)	6(20%)	3(10%)
Re-Operations	0	4(11%)	13(43%)	6(20%)
Removal Implants				
Neural Entrapments	0	4(11%)	12(40%)	5(17%)
Infection	0	0	1(3%)	1(3%)

DISCUSSION

The reported advantages of lumbar spine internal fixation are an increased rate of fusion, immediate spinal stabilization, prevention of foraminal collapse, and control of lumbar curve. There have been few studies comparing fusion results by various techniques, and prospective studies are difficult to run in a clinical surgical setting. Although this is a retrospective study and therefore subject to many flaws in experimental design, many

variables have been controlled by matching the groups from the large population from which they were derived.

Conclusions from this data must be specific to the diagnosis and internal fixation devices utilized. Presently it is unclear whether some of the new fixation systems not studied here may be more efficacious. In addition, the VSP system which has evolved in design since this series would be expected to be associated with a lower rate of implant failure currently.

The data suggests that there is no advantage to the addition of internal fixation to posterior lateral fusions for the treatment of herniated disc with clinical instability. Harrington rod fixation results were worse than no internal fixation and the other internal fixation techniques. This is significant at the .05 level by chi square due to the high incidence of postoperative neural entrapment. VSP and Knodt systems had less good and excellent results than no internal fixation, but the differences are not statistically significant. When a second operation for removal of implants is not considered a failure, results of group I(NIF), II(KR) and IV(VSP) are equivalent. The Harrington instrumentation remained inferior with a 27% failure rate after revision surgery and this is also statistically significant at the .05 level.

High wound infection rates (up to 5%) have been reported by several authors in their initial experience using pedicular fixation devices.[17,21,22] Two wound infections in this series in the HR and VSP groups were not statistically significant though supportive of the likelihood that metallic implants are associated with increased rate of infection.

The incidence of degeneration of the juxta-fusion segment has been discussed by Lee and Hsu.[7,10] Distraction devices [group II(KR) and III(HR)] obliterate the lumbar lordosis and place the first mobile segment in a hyperextended position. Abnormal stress distribution to the juxta-fusion segment is expected. If enough lumbar levels are greatly flexed the problematic flatback syndrome may result as described by Kostuik.[9] The VSP system (group IV) has the theoretical advantage of enabling maintenance of the lumbar lordosis even when discectomy is performed. A faster rate of juxta-fusion segment deterioration in cases of internal fixation is reported by Hsu et al. It is of note that patients were given diagnoses of juxta-fusion symptomatology in the techniques involving distraction, 6% and 13% in group II(KR) and group III(HR), respectively. On the other hand, there were no complaints referred to the juxta-fusion segment in group I(NIF) and 3% in group IV(VSP). Other factors which may implicate internal fixation in shortening the life of the juxta-fusion segment are

increased rigidity to the fused segments which results in a greater stress riser at the first mobile segment and weakening of the juxta-fusion to fusion facet articulation by surgical dissection. The latter can usually be avoided by appropriate surgical technique.

In this series, there is no significant difference in pseudarthrosis rates between groups. Group IV(VSP) had the lowest,10%, and group III(HR) had the highest with 20%.

There were no re-operations required in group I(NIF), while significant numbers were required in groups II(KR)-11%, III(HR)-43%, and IV(VSP)-20%. In group III(VSP), 5/6 had re-operation related to broken screws. As mentioned, current rate of breakage with VSP instrumentation has been lower in our experience. The distortion of imaging by metallic implants makes evaluation of postoperative internal fixation patients more difficult. In some situations, symptoms may be presumed due to implants because adequate imaging is impossible. Surgery to explore the surgical site and remove the implants may or may not be useful.

CONCLUSIONS

Although great advances have been made in lumbar internal fixation systems, those studied here as an adjunct to posterior lateral fusion for herniated discs and clinical

instability resulted in less favorable results than no internal fixation. There was no statistically significant benefit in the use of internal fixation with posterior lateral fusion and discectomy using the implants studied. Standard Harrington rod instrumentation was inferior to other techniques. The incidence of symptoms requiring reoperation for removal of implants was significant with Knodt rods, Harrington rods and VSP plates. Based on this retrospective study, the authors recommend limiting the use of lumbar instrumentation to unstable fractures, failed fusions with frank instability, situations in which the degree of instability is so great as to necessitate immediate stabilization, or in which failure of fusion is expected.

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